

# Rediscovered after almost 100 years: new faunistic data of *Thaumalea rumanica* with additional records of Thaumaleidae from Romania

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Received 8 February 2021 | Accepted 25 May 2021 | Published 30 June 2021

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**Citation:** Keresztes L, Dénes A-L (2021) Rediscovered after almost 100 years: new faunistic data of *Thaumalea rumanica* with additional records of Thaumaleidae from Romania. *Travaux du Muséum National d'Histoire Naturelle "Grigore Antipa"* 64(1): 119–129. <https://doi.org/10.3897/travaux.64.e64110>

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## Abstract

*Thaumalea rumanica* is a member of the family Thaumaleidae and it has been described from a few localities surrounding Băile Herculane, south-west Romania. Since its discovery, no further data were published on this endemic species of restricted range from the Carpathian region. On August 18, 2020 a single male specimen was collected at Poiana Mărului, in Olteana valley, south-west Romania, at 720 m altitude by the present authors, which is farther north from its typical location. This new finding suggests a larger distribution of the species in the Southern Carpathians. Based on our recent faunistic survey, a new species, *Thaumalea remota* was added to the Thaumaleidae fauna of Romania, with a revised checklist of the family, based on both personal and recent literature data.

## Keywords

New records, distribution, checklist, Thaumaleidae, Romania.

## Introduction

Thaumaleidae is a family of small aquatic dipterans with roughly 185 species that have been described worldwide. They are best represented in the Holarctic region, with only a few species being recorded from the southern hemisphere (Pape et al. 2011; Pivar et al. 2019). Their common names, such as solitary midges or trickle midges, suggest strong affinities to madicolous or hygropetric habitats, where larvae are often found in the thin microfilm of water that flows over rocky surfaces, cascading streams, and splash zones near waterfalls and boulders in fast moving streams (Marshall 2012). Adult Thaumaleidae are small-sized Diptera, having conspicuously curved vein R<sub>2+3</sub> and antenna tapered and slender, which readily differentiates them from Simuliidae, which greatly resemble. Due to their habitat specificity and poor flight ability, Thaumaleidae are less frequently collected and mostly neglected all over their distribution area (Papp 2018).

According to recent revisions of Thaumaleidae, about 80 species occur in different mountainous systems of Europe (Martinovský and Rozkošný 1976; Vaillant 1977; Wagner 2002, 2016). Despite their limited dispersal abilities, important genetic structuring through geographic isolation, high habitat specificity and fragmented distribution of the majority of taxa, this particular family of Diptera has received less attention in recent phylogeography and biogeography studies of aquatic insects across Europe (Haubrock et al. 2017). Hence, a large majority of overlooked or cryptic taxa still remain to be discovered using an integrative approach.

Thaumaleidae is one of the most neglected and underestimated groups in the Diptera family in Romania. The first faunistic data on Thaumaleidae of Romania were recorded by Thalhammer (1900). In his comprehensive work on Diptera from the Carpathian Basin area, he recorded only two species from Transylvania, *Thaumalea testacea* Ruthe, 1831 from Mehadia, and *Androprosopa nigra* (Loew, 1871) from Bucegi area. Later, a new species, *Thaumalea rumanica* Edwards, 1929 from Băile Herculane was described by Edwards. Tjeder (1949) recorded *Thaumalea edwardsi* Tjeder, 1949 from the same locality, Vaillant (1969) added *Thaumalea botosaneanui* Vaillant, 1969 from the Retezat and Bucegi Mountains, and *Thaumalea tatica* Vaillant, 1969 from the Bucegi Mountains of the Southern Carpathians group, and Wagner (1988) contributed with *Thaumalea similis* Wagner, 1988 from the Harghita Mountains of the Eastern Carpathians group. All of these species were only described from the territory of Romania, except for *A. nigra*, *T. testacea* and *T. tatica*, and they are micro-endemic species that have not been collected since their respective descriptions.

In the last 100 years, only sporadic faunistic data have contributed to the list of Thaumaleidae of Romania with additions of some more widespread species, as follows: *Androprosopa larvata* (Mik, 1888) (Zilahy-Sebess 1956, 1960; Papp 2018), *Thaumalea bezzii* Edwards, 1929 (Vaillant 1969; Martinovský and Rozkošný 1988; Pârvu 2004; Moldovan 2007; Papp 2018) and *Thaumalea truncata* Edwards, 1929 (Pârvu 2004). In total, 11 species, and two additional but doubtful species, *Thaumalea dinarica*

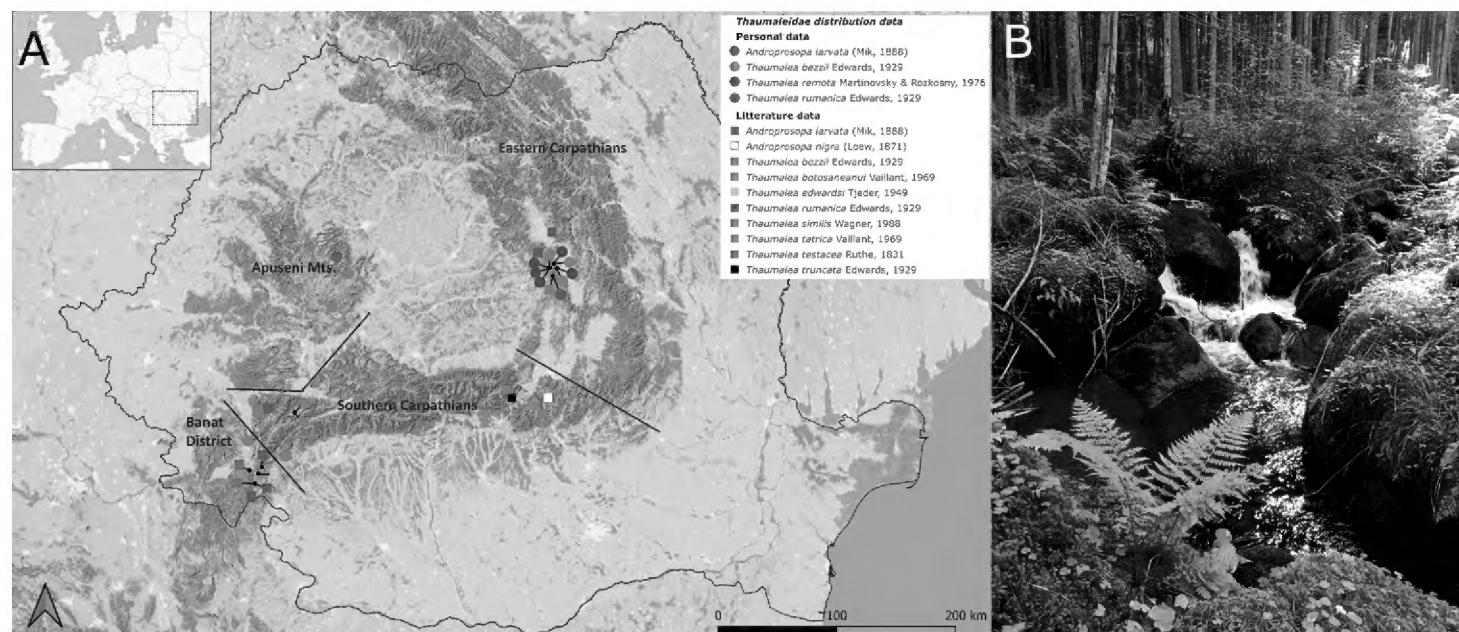
Schmid, 1958 (Martynovsky and Rozkovsny 1988) and *Thaumalea mixta* Edwards, 1929 (Jong et al. 2014), were recorded from Romania.

In the present paper, new faunistic data and several new localities are recorded for a number of Thaumaleidae from Romania, based on a personal collection of data over the past two years of investigation in different mountains regions, but mostly in the Carpathian region. Finally, a checklist of Thaumaleidae of Romania is presented, based on the combined results of both literature and personal data.

## Material and methods

Thaumaleidae were collected by sweeping the riparian vegetation close to the larval habitats, or they were aspirated directly off the rock surface or associated moss (Fig. 1). The material, representing adult specimens, underwent dry preservation and were deposited in the Diptera Collections of the Faculty of Biology and Geology, affiliated to the Zoological Museum of the University of Babes-Bolyai, Cluj Napoca, Romania. Distribution data, based on personal collection data and compiled from literature data are presented in Fig. 1.

Male terminalia were left overnight in 10% KOH and for one hour in undiluted glacial acetic acid to neutralise and wash out the soap that was created from the soft tissues. Then, the male terminalia were transferred to a larger amount of glycerol in order to wash out the acid, and then to a drop of glycerol on a slide with rounded excavation. The slide was carefully transferred to the compound microscope in order to take the photos. Finally, the genital parts were placed in micro vials containing



**Figure 1.** A Historical (full square) and personal (full circles) distribution data on Thaumaleidae from Romania; B typical habitat for Thaumaleidae, brook with cascades, Harghita Mts., 1081 m altitude.

Black lines indicate limits of the geography units.

50–50% ethanol and glycerol and were pinned under the dry specimen. Nomenclature of the wing venation and genital structures is in accordance with Wagner (2002).

Photos of the wing were taken with an Olympus stereomicroscope (SZ51) with Cannon Camera (650D) attached. Photos of the genital structures were taken with a compound Olympus microscope (CX23) equipped with a set of standard planachromatic objectives (the camera was a Cannon 750D) and as stacking software we used Zerene Stacker. Stacking results consist of 10–15 single exposures with the stereomicroscope and 20–50 exposures with the compound microscope.

## Results

A total number of 56 specimens belonging to four species were collected between 2019 and 2020.

### First record of *Thaumalea remota* Martinovský and Rozkošný, 1976 in Romania

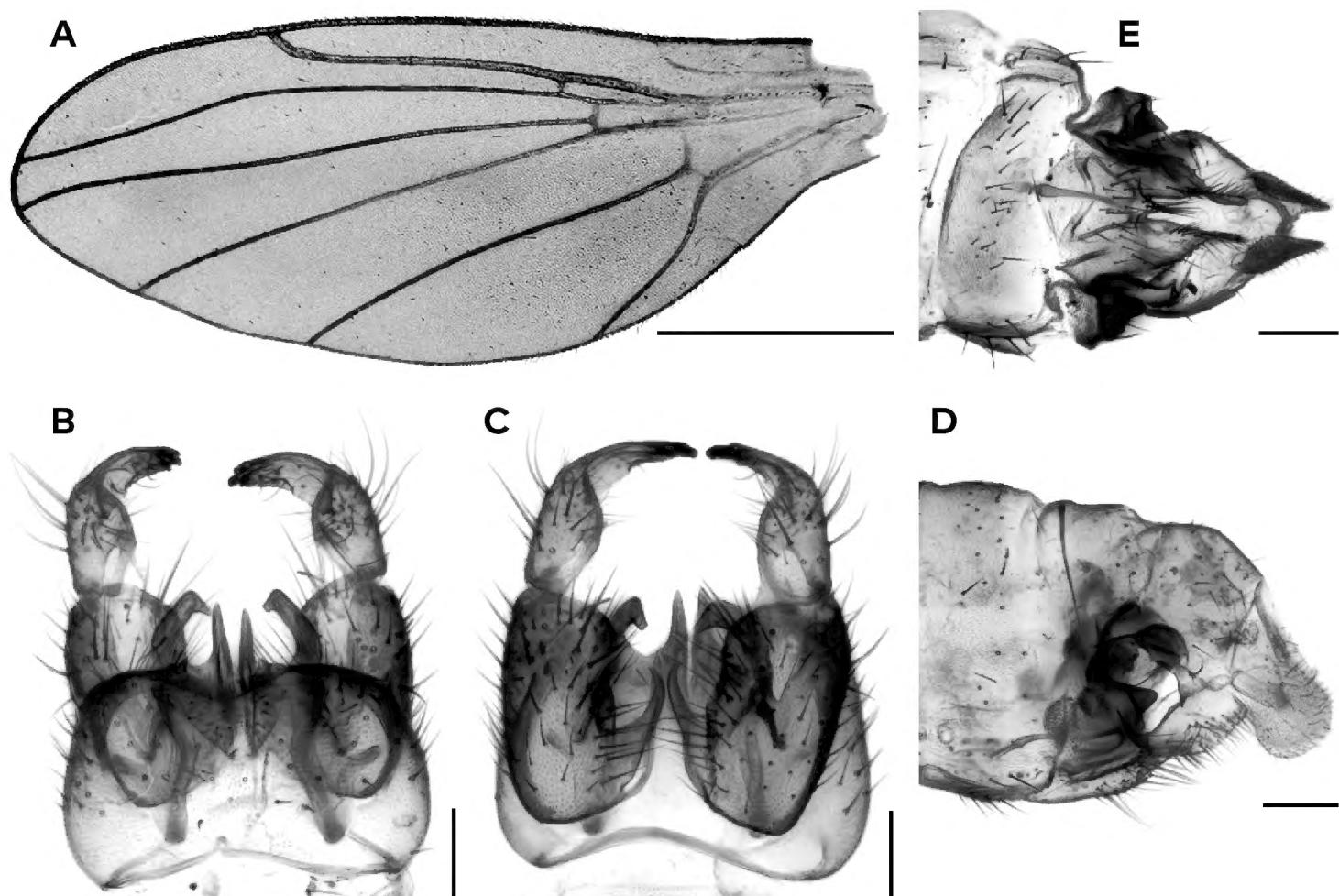
*Thaumalea remota* Martinovský and Rozkošný, 1976 – **2 males**: Racu, Harghita Mts., Kecskevész brook, near cascades, 2020.07.31 and 2020.08.26, 991 m, 46.446582°N, 25.672379°E, leg. Keresztes L.; **1 male**: Mădăraş, Harghita Mts., springs, 2020.09.04, 1088 m, 46.472418°N, 25.642936°E, leg. Keresztes L.; **1 male, 3 females**: Mădăraş, Harghita Mts., springs, 2020.09.04, 1410 m, 46.454253°N, 25.611142°E, leg. Keresztes L.; **4 males, 5 females**, Mădăraş, Harghita Mts., rheocren spring complex, 2020.09.04, 1560 m, 46.450092°N, 25.600569°E, leg. Keresztes L. Male left wing, male and female genitalia are presented in Fig. 2.

The species is new for the fauna of Romania. It was described by Martinovský and Rozkošný (1976) from different water courses in the Western Carpathians and from North Hungary (Papp 2003). The new population that was detected in the Harghita Mountains is distributed in a single brook valley with large boulders and cascades at an elevation of between 900 and 1600 m, and presumably is much more frequent along different watercourses in the whole of the Eastern Carpathians in similar habitats.

### New locality data on Thaumaleaidae of Romania

*Androprosopa larvata* (Mik, 1888) – **2 males**: Stațiunea Muntele Băișorii, Buscat, Muntele Mare Mts., 1551 m, open rheocren springs with isolated spruce fir trees, 2019.07.13, 1615 m, 46.532602°N, 23.283486 °E, leg. Keresztes L., 2019.07.27, 1551 m, 46.532602°N, 23.283486°E, leg. Keresztes L. Male head, left wing and genitalia are illustrated in Fig. 3.

This is the first record of the species from the Apuseni Mountains. The species has sporadic records from the Eastern Carpathians, with some old references from Băile Harghita, Harghita Mountains, up to an elevation of 1000 m (Zilahi-Sebess 1960), but quite recently more specimens were added from the Giurgeu and Gurghiu Mountains

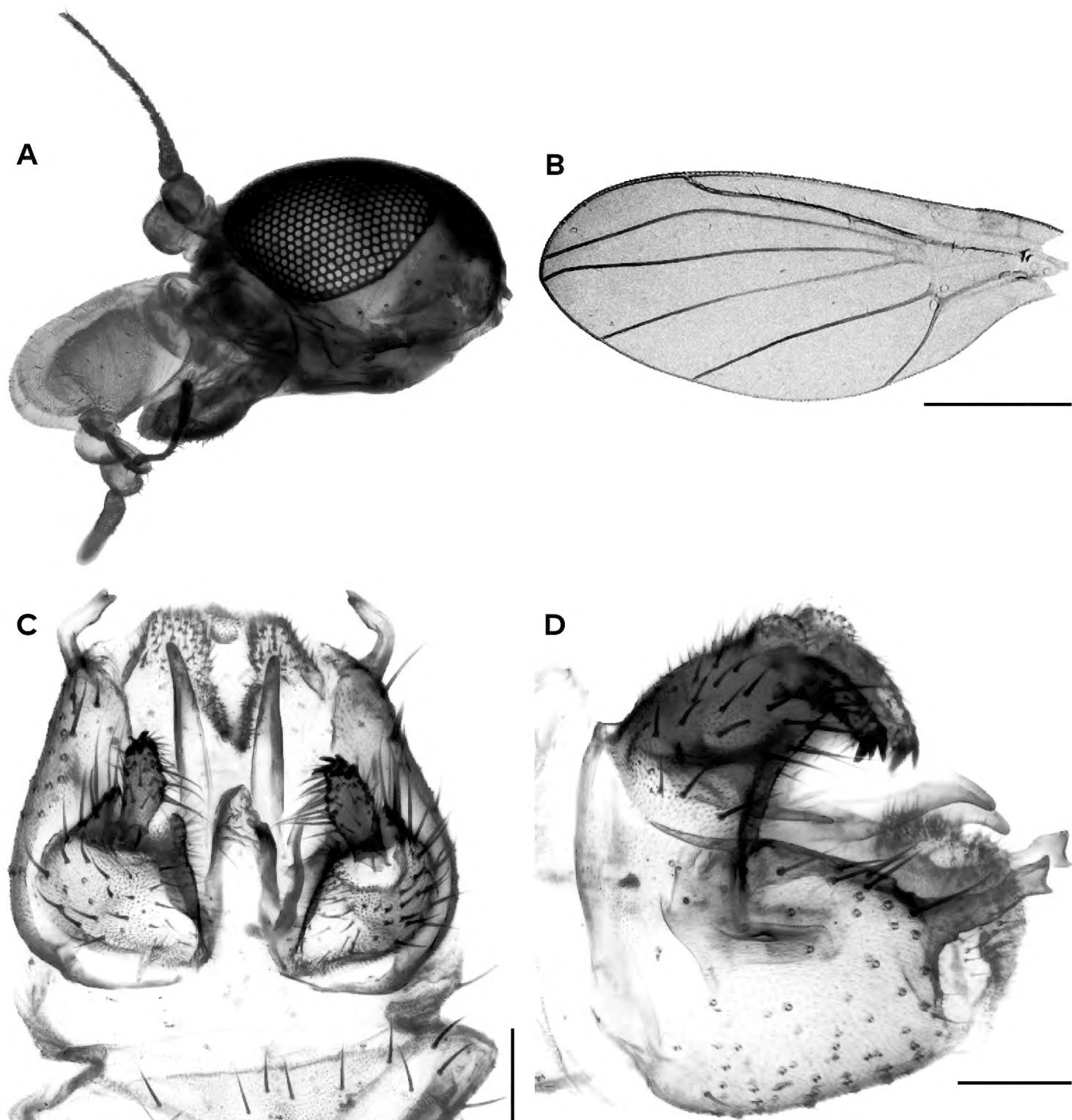


**Figure 2.** *Thaumalea remota* Martinovský and Rozkošný, 1976: **A** male left wing (scale bare 1 mm); **B** dorsal- and **C** ventral view of male terminalia; **D** lateral- and **E** ventral view of female terminalia (scale bares 0.2 mm).

(Papp 2018). It is noteworthy that the highly modified first palpomere of the male specimens (Fig. 3A), both from the Eastern Carpathians and the Apuseni Mountains, is similar to that in males recorded from Alpine regions, and contrasting with males having normally-shaped palps from the lower mountains in Central Europe. Based on these conspicuous differences in allopatric population from different mountainous regions in Europe, Papp (2018) introduced the concept of their being two different species, and also suggested comprehensive morphological revision of the species in its whole range. However, further molecular investigation is also needed to evaluate the presumably cryptic diversity of the species and its possible taxonomic implications. The populations identified from the Apuseni Mountains most probably represent an overlooked cryptic species, as the male terminalia is highly similar to individuals having normally shaped first palpomere, but with minor detected differences in the bifurcate appendix of the 9<sup>th</sup> abdominal segment (Figs 3 C, D).

***Thaumalea bezzii* Edwards, 1929 – 5 males, 4 females:** Rusca, Mehedinți Mts., 642 m, 2019.08.18, 45.154671°N, 22.424747°E, leg. Keresztes L.; Bratilovu, Mehedinți Mts., 660 m, 2019.08.17, 45.021705°N, 22.786849°E, leg. Keresztes L.; **3 females:** Sîlcia de Jos, Bedeleu Mts., 639 m, 2019.09.01, 46.405879°N, 23.466643°E, leg. Keresztes L.; **1 male, 1 female:** Telec, Ceahlău Mts., 1500 m, 2020.07.09, 46.954456°N, 25.935233°E,

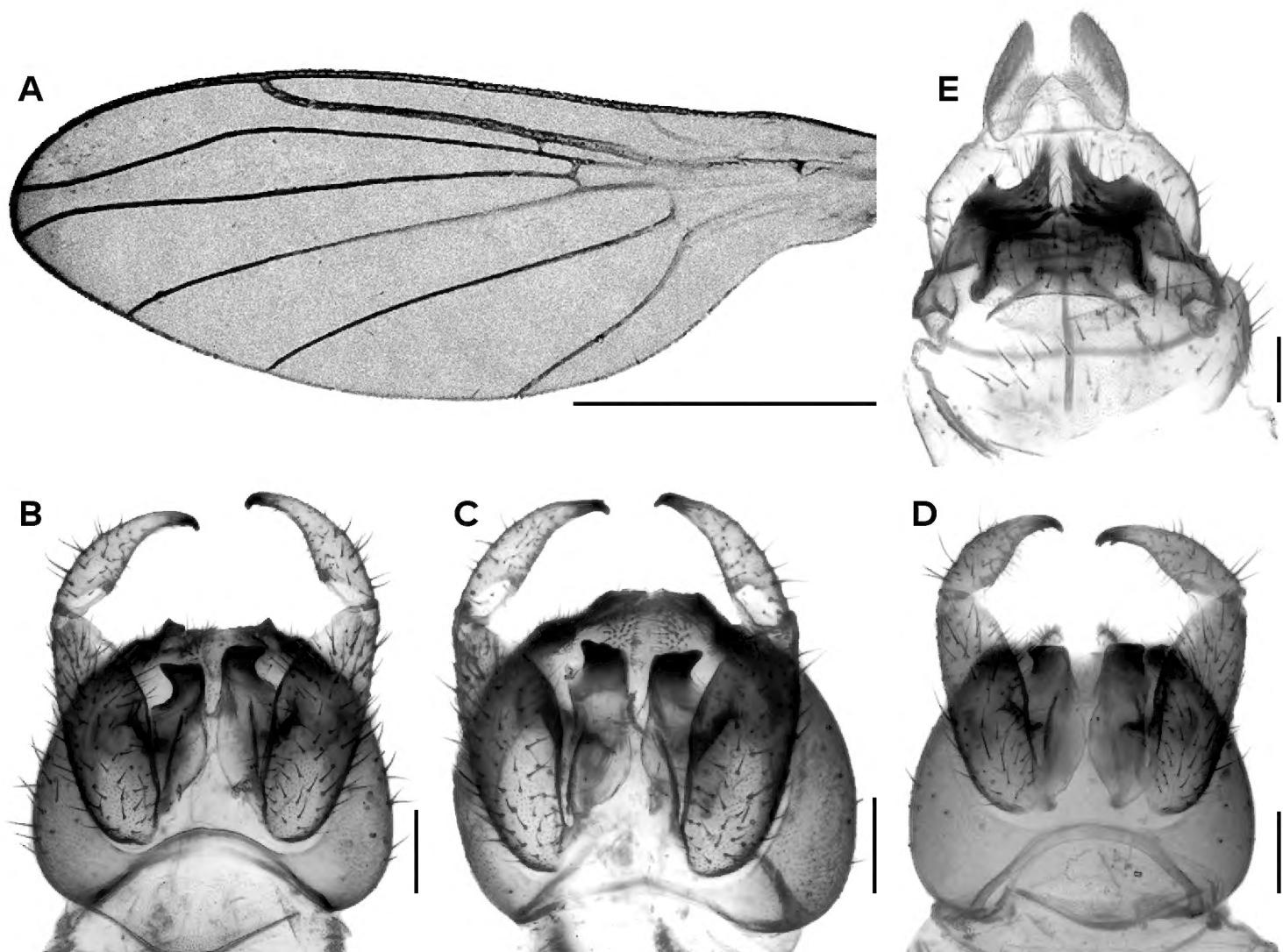
leg. Keresztes L.; **5 males, 4 females**: Poiana Mărului, Muntele Mic Mts., Valea Olteana, 1040 m, 2020.08.18, 45.352778°N, 22.523889 °E, leg. Keresztes L.; **1 male, 1 female**: Racu, Harghita Mts., Kecskevész valley, 1041 m, 2020.08.26, 46.447403°N, 25.669216°E, leg. Keresztes L.; **1 male, 1 female**: Mădăraş, Harghita Mts., 1088 m, 2020.09.04, 46.472418°N, 25.642936°E, leg. Keresztes L.; **5 males**: Răchițele, Vlădeasa Mts., Valea Sâncioiului, 910 m, 2020.09.12, 46.708758°N, 22.837722°E, leg. Keresztes L.; **1 female**: Fenes, Caprei Gorges, Trascăului Mts., 783 m, 2020.09.15, 46.155906°N,



**Figure 3.** *Androprosopa larvata* (Mik, 1888): **A** male head, with the conspicuously enlarged first palpomere; **B** left wing (scale bare 1 mm); posterior end of the male abdomen, **C** ventral, **D** lateral – ventral (scale bare 0.2 mm); Buscat, Muntele Mare, at 1550 m altitude.

23.287519°E, leg. Keresztes L.; **4 males**: Stațiunea Muntele Mic, Muntele Mic Mts., 1495 m, 2020.09.20, 45.360573°N, 22.484744°E, leg. Keresztes L.

This is the first record of the species from the Apuseni Mountains and Banat District. The species was recorded from the Eastern and Southern Carpathians of Romania by Vaillant (1969), Martinovský and Rozkošný (1976) and Pârvu (2004). The species is widespread all over Europe, and, based on recent distribution data, we can assume that in Romania it is also more widespread along different brooks and at different altitudes than was previously presumed. However, based on the insular distribution of local populations in the species larger distribution area in Europe, and due to some external habitat requirements of larvae to spring, waterfalls and cascades, a large variability of the basistylus, dististylus and paramere of the male genitalia were detected, mostly from the Central and South-eastern part of Europe, without clear allopatric structuring, discussed in detail by Wagner (2002). Important variability of the male genital structures, mostly the distal end of the interior process of the basistylus (Figs 4 B, C, D) were also detected by us on different populations in Romania, too, and we cannot exclude the possibility of divergent evolution of some local populations, as noted also by Papp (2018).

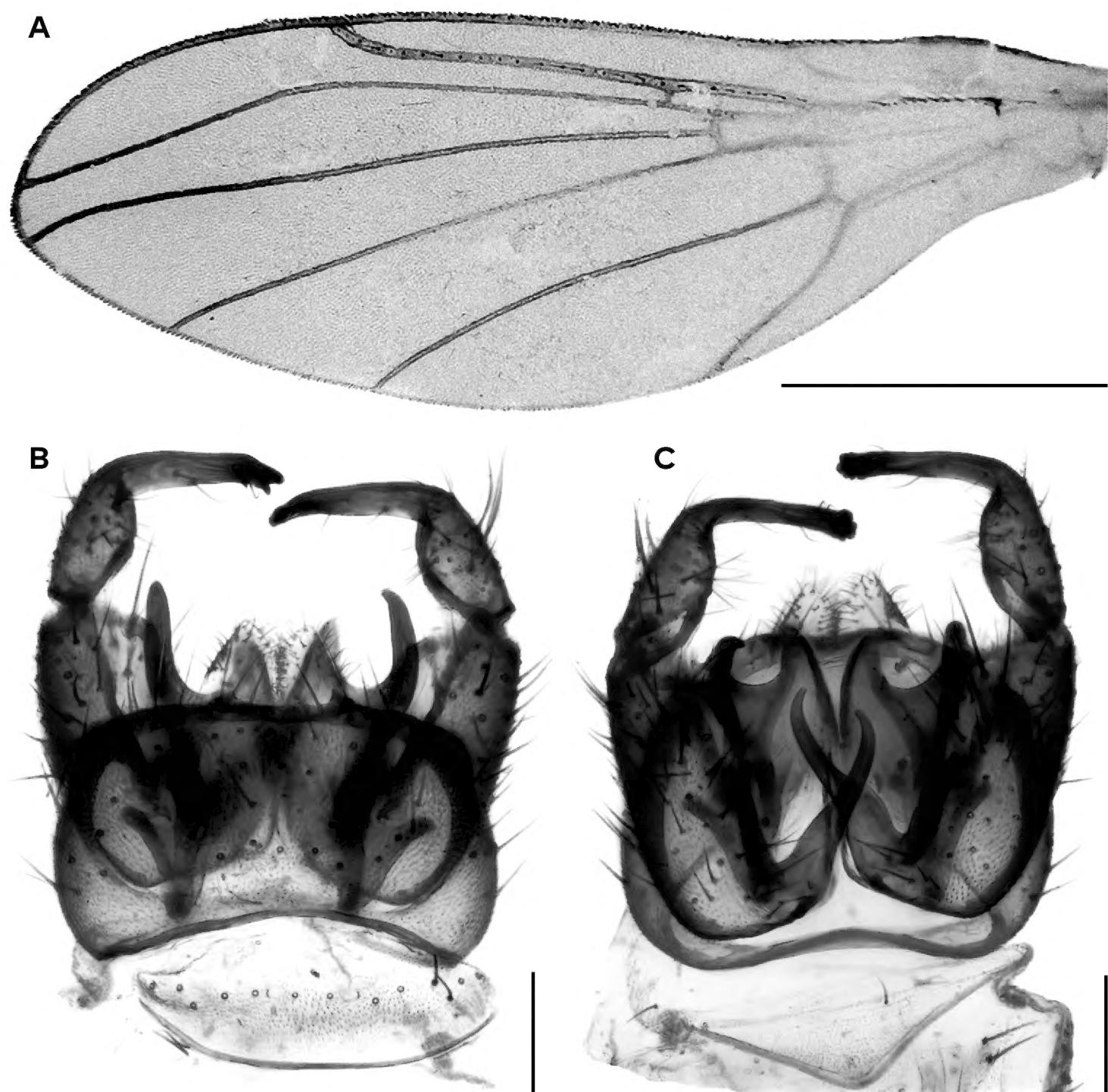


**Figure 4.** *Thaumalea bezzii* Edwards, 1929: A male left wing (scale bare 1 mm), terminalia of the male abdomen, ventral; B specimen from Rusca, Banat area; C specimen from Telec, Eastern Carpathians; D specimen from Răchițele, the Apuseni Mts., (scale bare 0.2 mm).

Male right wing, the variability of the male genital structures, and the female genitalia are illustrated in Fig. 4.

*Thaumalea rumanica* Edwards, 1929 – **1 male:** Poiana Mărului, Valea Olteana, Muntele Mic Mts., 2020.08.18, 720 m, 45.387318°N, 22.534528°E, leg. Keresztes L.

This is the first record of the species from Romania, after 100 years of description, and also a new record for the Southern Carpathians. It was described from Băile Herculane (locus typicus), and two other nearby localities (Bârza, Ieșelnița) from the Banat District by Edwards (1929). Our recent data suggest that the species is more widely distributed in the Carpathians, than was previously assumed. It is important to



**Figure 5.** *Thaumalea rumanica* Edwards, 1929: A male left wing (scale bare 1 mm); B male terminalia, dorsal; C male terminalia, ventral (scale bare 0.2 mm).

have more distribution data for this rare and range-restricted endemic species from the Carpathian region. Male wing and terminalia are presented in Fig. 5.

A revised checklist and distribution of Thaumaleidae from Romania based on a combination of literature and personal data are presented in Table 1.

## Discussion

Based on our recent data collection exercise, the number of Thaumaleidae from Romania increased to 11 species (Table 1). However, a number of species described from Romania in the 1900s, which are also important range-restricted endemic species, were not recorded since their descriptions, except for the recently collected *T. rumanica* from the Southern Carpathians. These species are *T. botsosaneanui*, *T. edwardsi*, *T. similis* and *T. tetrica*. The random location and concentration of historical distribution data around some popular mountain tourist centres of the 1900s (Fig. 1) suggest that additional species are expected to occur, especially from areas with a high level of aquatic endemism, such as the Apuseni Mountains or the northern part of the Romanian Carpathians. It is also noteworthy that there is conspicuously allopatric structuring of some fine details in the male terminalia of some other species with wider distribution, such as *A. larvata* and *T. bezzi*. This also suggests important cryptic diversity or putative overlooked species, and the emerging need for a more

**Table 1.** List of Thaumaleidae species from Romania based on literature and recent distribution data. 1 – Banat District, 2 – Southern Carpathians, 3. Eastern Carpathians, 4. The Apuseni Mts.

Thaumaleidae	1	2	3	4	Source of data
1. <i>Androprosopa larvata</i> (Mik, 1888)	-	-	+	+	Papp 2018, personal data
2. <i>Androprosopa nigra</i> (Loew, 1871)	-	+	-	-	Zilahi-Sebess 1960 Martinovský and Rozkošný 1976
3. <i>Thaumalea bezzii</i> Edwards, 1929	-	+	+	+	Vaillant 1969, Pârvu 2004 Papp 2018, personal data
4. <i>Thaumalea botsosaneanui</i> Vaillant, 1969	-	+	-	-	Vaillant 1969, Martinovský and Rozkošný 1976 Papp 2018
5. <i>Thaumalea edwardsi</i> Tjeder, 1949	+	-	-	-	Martinovský and Rozkošný 1976 Papp 2018
6. <i>Thaumalea remota</i> Martinovský and Rozkošný, 1976	-	-	+	-	personal data
7. <i>Thaumalea rumanica</i> Edwards, 1929	+	+	-	-	Zilahi-Sebess 1960, pers. data Martinovský and Rozkošný 1976
8. <i>Thaumalea similis</i> Wagner, 1988	-	-	+	-	Wagner 1988, Papp 2018
9. <i>Thaumalea tetrica</i> Vaillant, 1969	-	+	-	-	Vaillant 1969, Martinovský and Rozkošný 1976
10. <i>Thaumalea testacea</i> Ruthe, 1831	+	-	-	-	Thalhammer, 1900 Zilahi-Sebess 1960
11. <i>Thaumalea truncata</i> Edwards, 1929	-	+	-	-	Pârvu 2004

comprehensive molecular taxonomy revision of the Thaumaleidae material collected from the region.

## Acknowledgements

The first author would like to thank László Papp, one of Europe's reference scientists in the study of Diptera, for inspiration and for drawing attention to this interesting fly family, Thaumaleidae. The present work received financial support from a national grant offered by the Executive Unit for Financing Higher Education, Research, Development and Innovation, UEFSCDI, of the Ministry of Education and Research, PN-III-P2-2.1-PED-2019-0214; nr. 476PED/2020. We thank Matthey Coupley for linguistic revisions and comments.

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